35 (amended). The apparatus of claim [33] 29, wherein [said matched filter includes a conjugate of a chirp signal] M equals one.

Please add the following new claims:

39 (new). The apparatus of claim 38, wherein M equals one.

40 (new). The apparatus of claim 24, wherein each transducer element includes non-linear electro-acoustic material.

REMARKS

Patented claims 1-23 and reissue claims 24-38 are pending. New claims 39-40 are added by this amendment. As requested by the Examiner a separate document entitled "Supplemental Paper Correctly Amending Reissue Application" is submitted herewith which provides previous amendments to the specification and claims as required by §1.173. A declaration under §1.175 that incorporates language suggested by the Examiner will be submitted shortly by facsimile.

Claims 24-28 and 30-37 stand rejected as being improper recapture of broadened claimed subject matter.

Applicant has amended claim 24 to include "active device" limitations similar to those in allowed reissue claim 29 (and in patented claim 16). Applicant submits that claim 24 is allowable for reasons similar to those that support allowance of claim 29.

Claim 30 has been amended herein to include the limitations suggested by the Examiner regarding "modification" of the frequency and phase components. Claim 30 now recites:

> " … in such a manner as to modify the frequency and phase of the transducer element's electrical receive signal so as to achieve the coherent combination of the modified electrical receive signals from all of said plurality of transducer elements …".

This language is, in part, identical to language in patented claim 1 (see col. 16, lines 2-5). Applicant submits that claim 30 with this limitation is not improper recapture.

Claims 28 and 35 have been amended to recite that M equals one. A 1-D array is shown in Fig. 12 and discussed throughout the specification, particularly beginning at col. 14, line 54. The dependency of claim 35 has been changed to depend from claim 29.

New claim 39 also recites that M equals one. New claim 40 recites that "each transducer element includes non-linear electro-acoustic material." Similar limitations are presented in patented claims 11 and 19.

Applicant wishes to express appreciation for the Examiner's continued assistance in the present case which from initial prosecution through re-issue has lasted many years.

In view of the foregoing Amendments and these Remarks, Applicant submits that reissue claims 24-40 include limitations that render them proper and permissible in view of 35 U.S.C. §251. Early notification of allowance is respectfully requested. Should the Examiner believe that a telephone conference would help further the prosecution of this case, the Examiner is requested to contact the undersigned at the listed telephone number.

The Assistant Commissioner is hereby authorized to charge underpayment of any fees (including any filing fees under 37 C.F.R. §1.16 for additional claims and any patent application processing fees under 37 C.F.R. §1.17 including any fee for extension of time) associated with this communication or credit any overpayment to Deposit Account No. 01-0272. A duplicate copy of this authorization is enclosed.

Respectfully Submitted
on behalf of Applicant,

Date: 12-23-02

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SUPPLEMENTAL PAPER CORRECTLY AMENDING REISSUE APPLICATION

I). Amendments to Specification Under §1.173(b)(1):

Amend the paragraph at Col. 1, lines 9-23, as follows:

Conventional acoustic wave imaging systems use a one dimensional (1-D) array of electro-acoustic transducers, for example, a 1 X 100 array, and have been configured to achieve linear, curved linear and sector scanning. Coherence in the transmission and receipt of acoustic signals is achieved by the utilization of delay devices in the signal processing channels. Present one dimensional systems are disadvantageous due to (1) the manner in which they are constructed and (2) inherent limitations in their scanning capabilities. With respect to the manner in which they are constructed, one disadvantage is that the use of delay elements[,] and related electronics adds considerably to the cost of one dimensional systems. With respect to inherent limitations, one dimensional scanning systems are disadvantageous in that they only provide two dimensional images.

Insert the following paragraph at Col. 2, line 19:

It is also an object of the present invention to transmit and/or receive acoustic energy with these 1-D or 2-D acoustic arrays.

Amend the paragraph at Col. 2, lines 19-21, as follows:

These and related [objective] objectives of the present invention are achieved by use of the acoustic wave imaging system and method described herein.

Amend the paragraph at Col. 2, lines 41-49, as follows:

In one embodiment, the present invention comprises a plurality of electro-acoustic [transducer] transducers, each capable of generating an electrical signal indicative of an incident acoustic wave; means in communication with each [transducers] transducer for generating a coded signal for

transmission by each of said transducers; and means in communication with each of said transducers for modifying a coded signal received by the transducers to achieve a desired delay.

Amend the paragraph at Col. 2-3, lines 62-4, respectively, as follows:

And in yet another of many embodiments, the present invention includes an array of electro-acoustic transducers having a plurality of rows and columns; a plurality of row control lines, each of which is coupled to the transducers in one of said plurality of rows; a plurality of column controls lines, each of which is coupled to the transducers in one of said plurality of columns; and control means coupled to each of said plurality of row and column control lines for generating a control signal for each [transducers] <u>transducer</u> that is a combination of control signals on the row and column control lines for that transducer.

Amend the paragraph at Col. 4, lines 13-34, as follows:

Referring to FIG. 1, a perspective view of an acoustic wave imaging system 10 in accordance with the present invention is shown. The system 10 includes interface circuit 20 which is connected via line 85 to operator interface componentry represented by reference numeral 80 and via line 75 to a display mechanism 70. Both the operator interface componentry 80 and the display mechanism 70 are known in the art and are discussed in more detail below with reference to FIG. 3. The interface circuit 20 is also connected, via line 22, to a row control circuit 30 and, via line 28, to a column control circuit 40. The row and column control circuits 30,40 control the phase and frequency of signals propagated to a plurality [a] <u>of</u> M rows and N columns in an array 100 of acoustic transducer elements. Each transducer element [comprises a acoustic transducer] (cells 110,[120,]140,170,180,190 are indicated in FIG. 1) [and its] <u>includes a</u> corresponding transducer (shown in FIG. 2). The row control signals are propagated over M row control lines or

processing channels, represented generally by arrow 35, and the column control signals are propagated over N column control lines or processing channels, represented generally by arrow 45.

Amend the paragraph at Col. 5, lines 46-58, as follows:

FIG. 2 illustrates 9 transducer cells 110 [(not labelled in FIG. 2 due to crowding in the figure, but labelled in FIG. 1)], 120,130,140,150,160,170,180,190 and their corresponding acoustic transducers 115,125,135,145,155,165,175,185,195. In the composite implementation, each transducer is mounted to its corresponding cell in the same manner that transducers are connected to semiconductor substrates in IR focal plane arrays or the like. The dotted lines are provided to indicate that the number of cells is variable and may be modified in either dimension. Cell 150 is surrounded by a dashed line and will be described as a representative cell.

Amend the paragraph at Col. 5, lines 46-58, as follows:

The row control circuit 30 consists of a plurality of individual row signal generating circuits 231. A first of these [in] is connected via line 251 to the first mixer of cells 110,120,130. Similarly, a second and a last row signal generating circuit 231 are connected via lines 252 and 253 to cells 140,150,160 and cells 170,180,190, respectively. The column control circuit 40 consists of a plurality of individual column signal generating circuits 241. A first of these [in] is connected via line 261 to the first mixer of cells 110,140,170. A second and a last column signal generating circuit 241 are connected via lines 262 and 263 to cells 120,150,180 and cells 130,160,190, respectively.

Amend the paragraph at Col. 7, lines 5-13, as follows:

Referring to FIG. 4, a frequency versus time diagram is shown for a linear FM chirp. Chirps as a characterized electrical signal and matched filters therefor are generally known. Though

an up chirp is shown it should be recognized that since the attenuation of sound is strongly dependent on frequency, a down chirp may also be used and may be more appropriate in some instances. Furthermore, it may also be appropriate to transmit high frequencies at a higher voltage level.

Amend the paragraph at Col. 9, lines 8-22, as follows:

FIG. 2 shows several cells and transducers of the active 2-D array 100. Here each array element is connected to the output of its own electronic mixing circuit. One input of [the] each mixer is connected to an electrode that is shared by all other array elements on a given row. Likewise, the other input is connected to the corresponding column electrode. Mixing the external row and column signals together produces two signal components at each array element, one that is the sum of the frequency and phase of the row signal and column signal, and the other which is the difference. By choosing the frequency of the row and column signals such that only the difference (or sum) frequency is within the pass-band of the transducer ensures that only the difference (or sum) frequency (and phase) component will be radiated from the array.

Amend the paragraph at Col. 9, lines 40-46, as follows:

Together with array 100, control signal generators 30,40 comprise the beamforming process of system 10. The frequency and phase of the row and column array control signals determine the focus and angle of the transmit and receive beams in accordance with the equations herein. Having generally introduced transmit and receive operations, broadband applications [is] <u>are</u> now discussed.

II). Amendments to Claims Under §1.173(b)(2):

Note that previous claim amendments were submitted on 6/5/01 and 7/19/02. The below text includes these claim amendments and indicates their date of submission.

Prior Claim Amendment (with data of amendment):

6/5/01

2 (amended). The apparatus of claim 1, wherein said coded signal is a chirp.

6/5/01

Claim 12, line 1, after "comprising:" please begin a new paragraph. Note that the requested carriage return and indentation are non-visible characters. Thus, Applicant is unsure of how to make this amendment pursuant to §1.173(b)(2) and (d).

6/5/01

13 (amended). The apparatus of claim 12, wherein said array has a plurality of rows and a plurality of columns each having one of said plurality of control channels associated therewith;

said control signal generating means further including means for generating row and column control signal components; and

wherein each transducer element is uniquely and simultaneously controlled by a combination of the row and column control signal components for that transducer element.

6/5/01

23 (amended). An acoustic imaging apparatus, comprising:

control logic;

a plurality of transducer elements arranged in an array, each coupled to said control logic and capable of transmitting an acoustic signal representative of an electrical transmit control signal propagated from said control logic and generating an electrical receive signal representative of an incident acoustic signal;

means within said control logic for generating an electrical transmit control signal for each transducer element that contains a frequency based coded signal and [cause] causing each transducer to emit an acoustic signal representative of said coded signal;

means for modifying the frequency and [chase] phase of an electrical receive signal of each transducer element for coherently combining reflected coded signals within the electrical receive signals thereof;

means coupled to said modifying means for decoding the combined reflected coded signals to achieve a time delay base on that coded signal; and

means coupled to said decoding means for generating image data from an output signal therefrom.

7/19/02

24 (amended). An acoustic energy transmitting apparatus, comprising:

a plurality of electro-acoustic transducer elements arranged in an M row by N column 2-D array;

control circuit for propagating row and column control signals for each of said M rows and said N columns, each control signal having a frequency and a phase component; and

wherein said transducer elements and said control circuit are configured so as to achieve a [mixing] combining at each transducer element of the frequency and phase components of the row and column control [signal] signals for that transducer element in such a manner as to provide a focused acoustic signal at a given focal distance and direction from said array.

6/5/01

26 (amended). The apparatus of claim 24, wherein said control circuit includes a control channel for each of said M rows and a control channel for each of said N columns, and wherein the number of control channels is fewer than the number [to] of transducer elements.

7/19/02

29 (amended). An acoustic energy transmitting apparatus, comprising:

a plurality of electro-acoustic transducer elements arranged in an M row by N column [1-D] array, where M and N are positive integers and at least one of M and N is greater than one; [and]

M row control lines, each coupled to the transducer elements in one of said M rows;

N column control lines, each coupled to the transducer elements in one of said N columns;

control circuit for propagating row and column control signals for each of said M rows and said N columns, a control signal for each transducer element being a combination of one of said row control signals and one of said column control signals;

a plurality of active devices, each coupled to one of said transducer elements for combining the row control signal and the column control signal of that transducer element;

wherein said transducer elements [and said], control circuit and active devices are configured so as to achieve a [mixing] combining at each transducer element of the row and column control [signal] signals for that transducer element in such a manner as to provide a focused acoustic signal at a given focal distance and direction from said array; and

wherein each of said electro-acoustic transducer elements is configured within said apparatus to function in a non-linear manner in operation.

7/19/02

30 (amended). An acoustic energy receiving apparatus, comprising:

a plurality of electro-acoustic transducer elements arranged in an M row by N column array;

control circuit for propagating row and column control signals for each of said M rows and said N columns, each row and

column control signal having a frequency and a phase component; and

wherein said transducer elements and said control circuit are configured so as to achieve a [mixing] combining at each transducer element of the frequency and a phase components of the row and column control [signal] signals for that transducer element with a resultant electrical receive signal corresponding to an acoustic signal incident on that transducer element; and

a filter that filters spurious frequencies output from the transducer elements;

wherein [the row and column control signals and said filter] said transducer elements, control circuit and filter are configured to coherently combine the electrical receive signal of each of said transducer elements and to achieve focused acoustic signal reception at a given distance and direction from said array.

6/5/01

33 (amended). The apparatus of claim 30, wherein said filter [is] includes a matched filter.

6/5/01

36 (amended). The apparatus of claim 30, wherein the transducer elements and the control circuit are configured such that the row and column control signals for each transducer element [contains a] contain an appropriate frequency and phase shift that, when combined with the electric signal corresponding to an incident acoustic signal at that transducer element, modifies the received electric signal in such a manner as to permit the coherent combination of the modified received electric [signal] signals from all of said plurality of transducer elements.

7/19/02

36 (amended). The apparatus of claim 30, [wherein the transducer elements and the control circuit are configured such that the row and column control signals for each transducer element contain an appropriate frequency and phase shift that, when combined with the electric signal corresponding to an incident acoustic signal at that transducer element, modifies the received electric signal in such a manner as to permit the coherent combination of the modified received electric signals from all of said plurality of transducer elements] <u>further comprising a circuit that generates image data from the coherent combination of transducer element receive signals</u>.

6/5/01

37 (amended). The apparatus of claim 30, wherein said control circuit includes a control channel for each of said M rows and a control channel for each of said N columns, and wherein the number of control channels is fewer than the number [to] <u>of</u> transducer elements.

<u>Please add the following new claim</u>:

7/19/02

38 (new). <u>An acoustic energy receiving apparatus, comprising:</u>

<u>a plurality of electro-acoustic transducer elements each capable of generating an electrical receive signal in response to an incident acoustic wave and arranged in an M row by N column array, where M and N are positive integers and at least one of M and N is greater than one;</u>

<u>control circuit for propagating row and column control signals for each of said M rows and said N columns, the control signal for each transducer element being a combination of the row and column control signals for that transducer element;</u>

<u>wherein said row and column control signals are configured, for each transducer element, such that when combined with the electrical receive signal of that transducer element the</u>

electrical receive signal is modified in such a manner as to permit the simultaneous processing of the modified electrical receive signals from said plurality of transducer elements;

a first circuit that combines the modified electrical receive signals of each of said transducer elements to form an array output signal; and

a second circuit coupled to said first circuit that generates image data from said array output signal.

STATUS OF CLAIMS AND SUPPORT FOR CLAIM CHANGES UNDER 37 C.F.R. §173(c)

Claims	Status	Support
1-23	pending	Not substantively amended, support in original specification.
24	pending	Claim 16, etc.
25	"	Not substantively amended.
26	"	Not substantively amended.
27	"	Not substantively amended.
28	"	Fig. 12, etc.
29	"	Allowed.
30	"	Claim 1, Fig. 2, etc.
31	"	Not substantively amended.
32	"	Not substantively amended.
33	"	Not substantively amended.
34	"	Not substantively amended.
35	"	Fig. 12, etc.
36	"	Figs. 1-3, etc.
37	"	Not substantively amended.
38	"	Allowed.
39	"	Fig. 12, etc.
40	"	Claims 11,19, etc.